SNIA Green Storage Program Overview
What are the Activities and Benefits of Being Involved

Wayne M. Adams
SNIA Green Storage Initiative Chair

SNIA Emerald™ Training

SNIA Emerald™ Power Efficiency Measurement Specification

Version 3.0

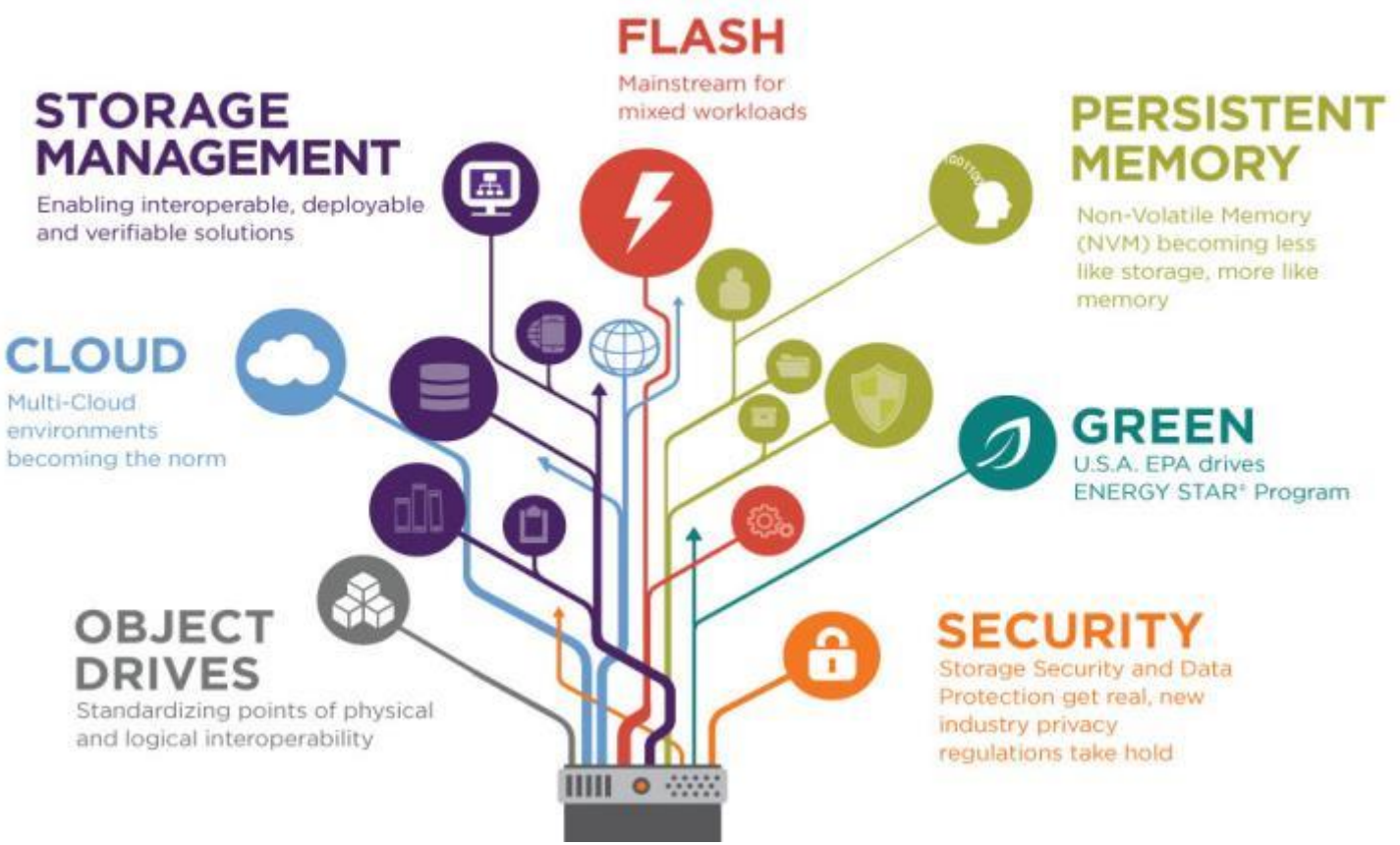
February-March 2018

SNIA Green Storage Activities Overview and Agenda

- SNIA Overview
- SNIA Green Storage Initiative (GSI)
- SNIA Green Storage Technical Working Group (TWG)
- SNIA Emerald™ Programs
- SNIA Membership and Benefits

SNIA in Action

SNIA GSI | GREEN STORAGE



SNIA Emerald™

Advancing Storage

SNIA GSI | GREEN STORAGE

Advancing Storage, Enabling the Future of IT

Leading the industry in developing and promoting standards, best practices and conformance testing programs.

Cloud Data Management Interface (CDMI)
Interoperability and portability of data stored and protected in the cloud

Storage Management
SMI-S for today's datacenters, and the emerging Swordfish for seamless management across servers, storage, and fabric

Software Defined Storage
Changes how storage will be managed and deployed in the Software Defined Data Center

Linear Tape File System (LTFS)
Bulk transfer to and from cloud environments

Transport Layer Security protocol
Secures communication between storage clients and servers

SNIA Emerald
Advances the measurement of energy efficiency for networked storage systems

SNIA Emerald™

Standards Development

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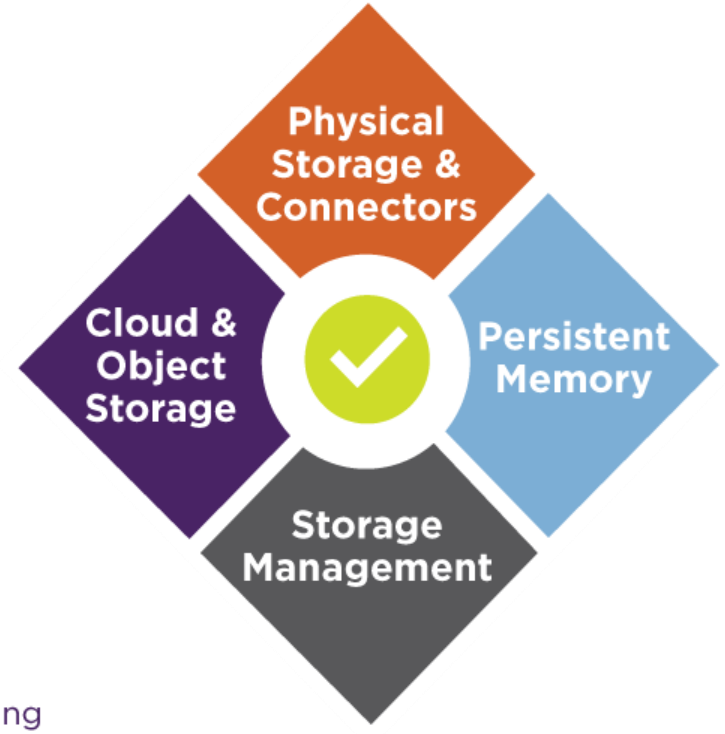
20 YEARS of Standards Development

- ISO & ANSI Standards
- Storage Standards
- Best Practices & Security
- Interoperability & Conformance Testing



About the
Storage Networking Industry Association

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SNIA-at-a-Glance

160
unique member companies

2,500
active contributing members

50,000
IT end users & storage pros worldwide

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SNIA Green Storage Overview

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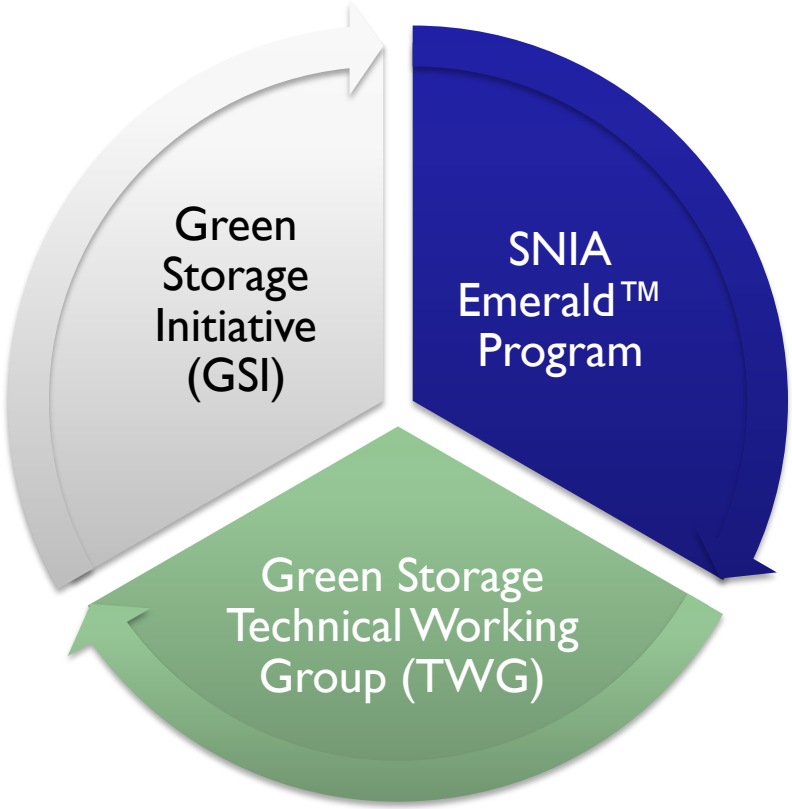
SNIA Initiative where SNIA members collaborate on market requirements, education, alliances, and events to promote energy efficient storage and the SNIA Emerald Program



SNIA program to promote usage by vendors and test labs of the SNIA Emerald Test Specification and for IT professionals to reference energy usage metrics for storage vendor products to aide storage system procurement planning and optimization of IT storage operations

SNIA committee of technical storage system experts defining storage system energy measurement methodology, energy usage-related metrics, technical specifications, and best practices

SNIA Emerald™

SNIA Green Storage Initiative (GSI)

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- Conducts research on power and cooling issues confronting storage administrators, data center operators, and industry regulators
- Educates the vendor and user community about the importance of power efficiency in shared storage environments
- Leverages SNIA and partner conferences to focus attention on energy efficiency for networked storage infrastructures
- Provides requirements input to the SNIA Green Storage TWG for green storage metrics and standards
- Provides external advocacy and support of SNIA Green Storage TWG technical work, cross-industry alliances with consortia and government agencies
- Operates the SNIA Emerald™ Program
- SNIA members pay an additional fee to join GSI; fees support engineering services in support of the Green Storage TWG deliverables

Green Storage Technical Working Group (TWG)

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- Technical body of storage experts developing green storage metrics and standards
- Develops the *SNIA Emerald™ Power Efficiency Measurement Specification*
- Develops *User Guide for the SNIA Emerald™ Power Efficiency Measurement Specification*
- Has path to ANSI and ISO de-jure standardization
- Operates under intellectual property policy protecting developers and users of work (as is typical of standards bodies)
- Any SNIA member can participate at no charge

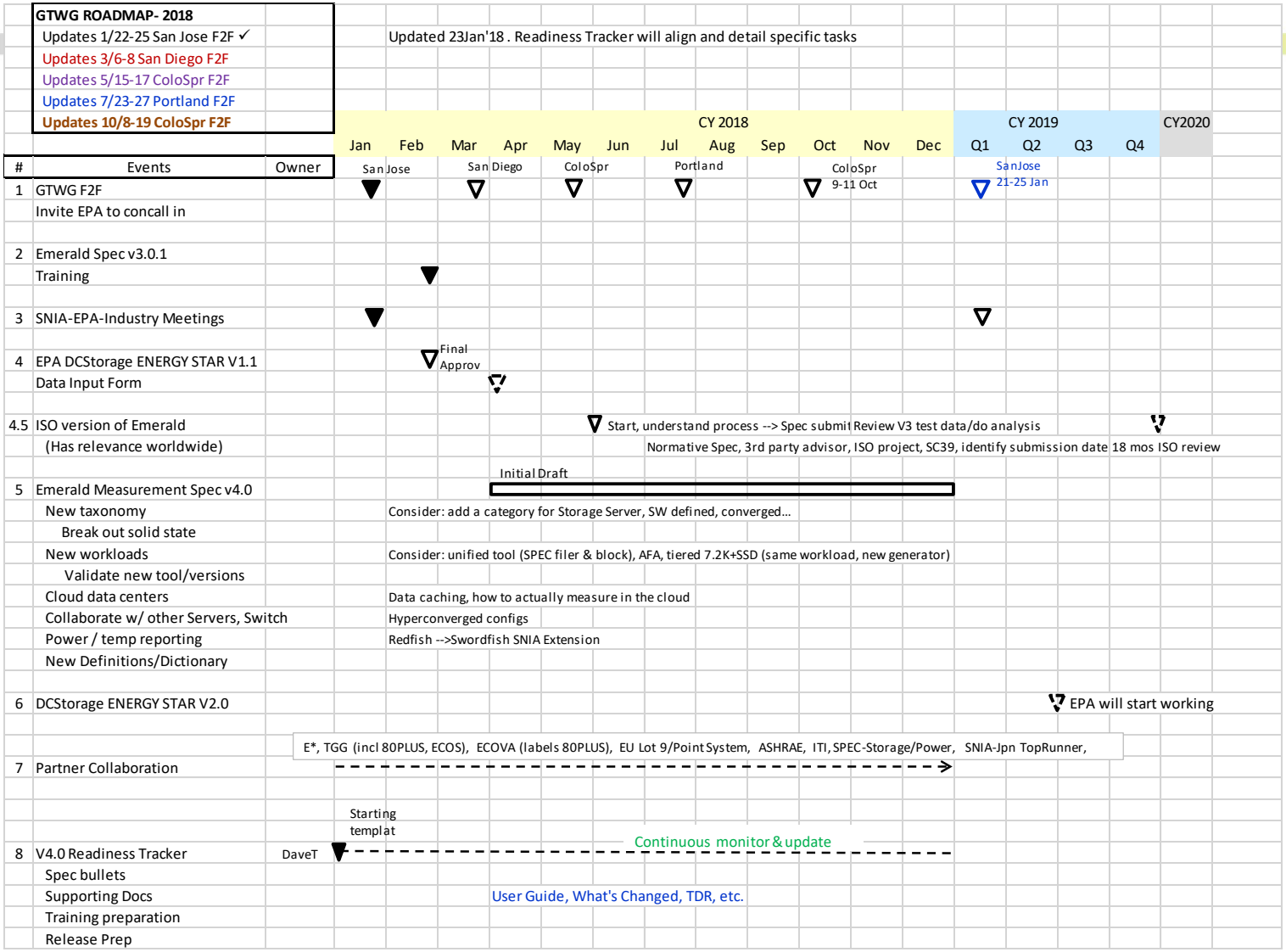
SNIA Emerald™ Program

- Operated by the GSI
- Overall program for the Emerald Specification
  - Program on storage power efficiency measurement and publication
  - Centered on *SNIA Emerald™ Power Efficiency Measurement Specification* – the methodology adopted by ENERGY STAR Data Center Storage program
  - Supporting materials, tools, training, web site, recognized tester program, Q&A support, and more….http://sniaemerald.com
- Seeks to
  - Provide unified storage industry voice with industry stakeholders
  - Train test engineers and independent labs to use repeatable methods
  - Stimulate the IT community to deploy and efficiently operate multi-vendor storage technology

SNIA Emerald™ Power Efficiency Measurement Specification

- Emerald Specification is the centerpiece of the Emerald Program
- Methodology adopted for ENERGY STAR Data Center Storage program by EPA; other global agencies in various stages of adoption ; EU Lot 9 and Japan Top Runner
- Specifies a rigorous methodology for measuring power efficiency of storage systems under typical data center conditions
- Status and Plans
  - Sept 2017 - V3.0 ; addresses online and near-online file server systems in addition to block IO (v2.1)
  - Submit 3.0.1 to ISO in mid-late 2018
  - Data analysis work 3.0 2H2018
  - Enable USA EPA Energy Star and Japan METI Top Runner programs in 2018
  - V4.0: address solid state storage-based devices, converged storage, object storage, revised taxonomy

SNIA Green Roadmap



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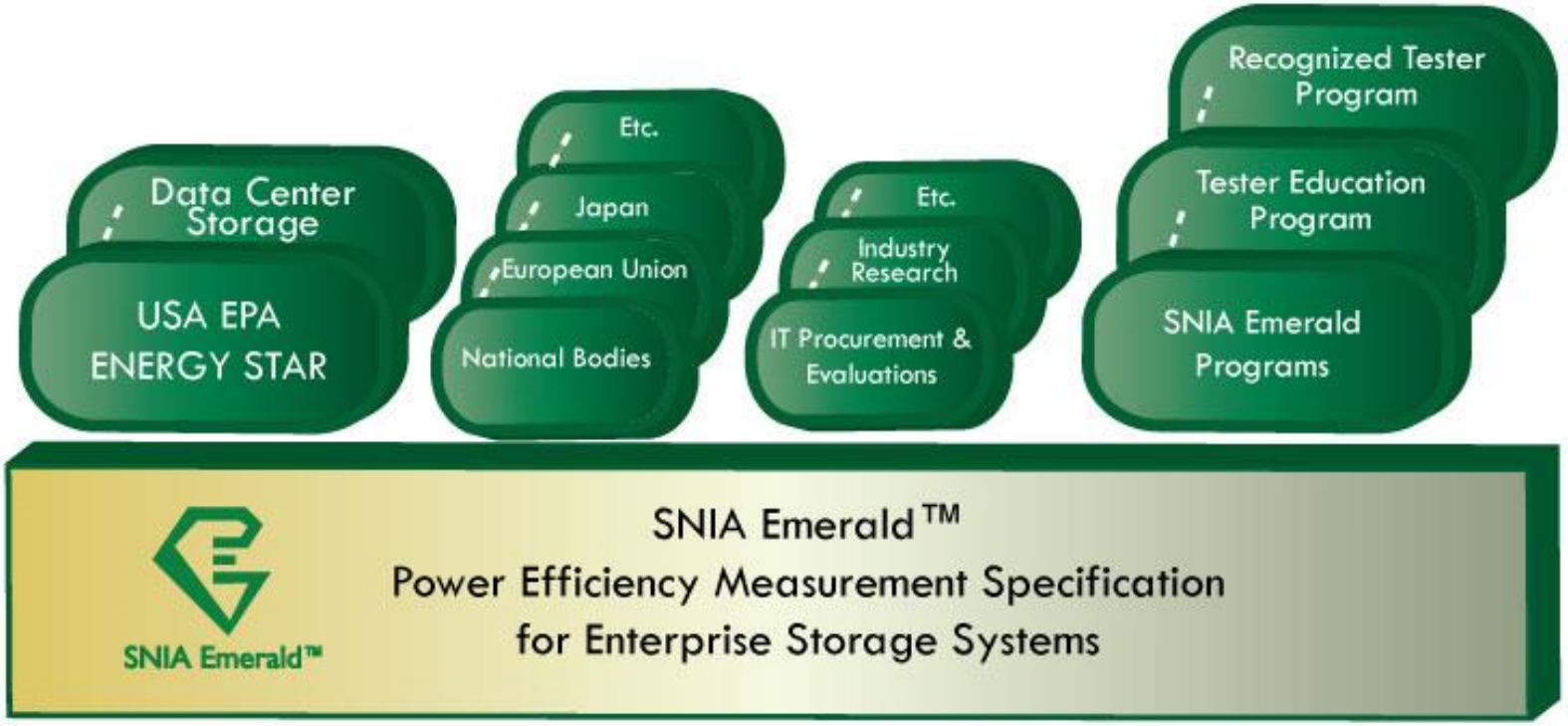
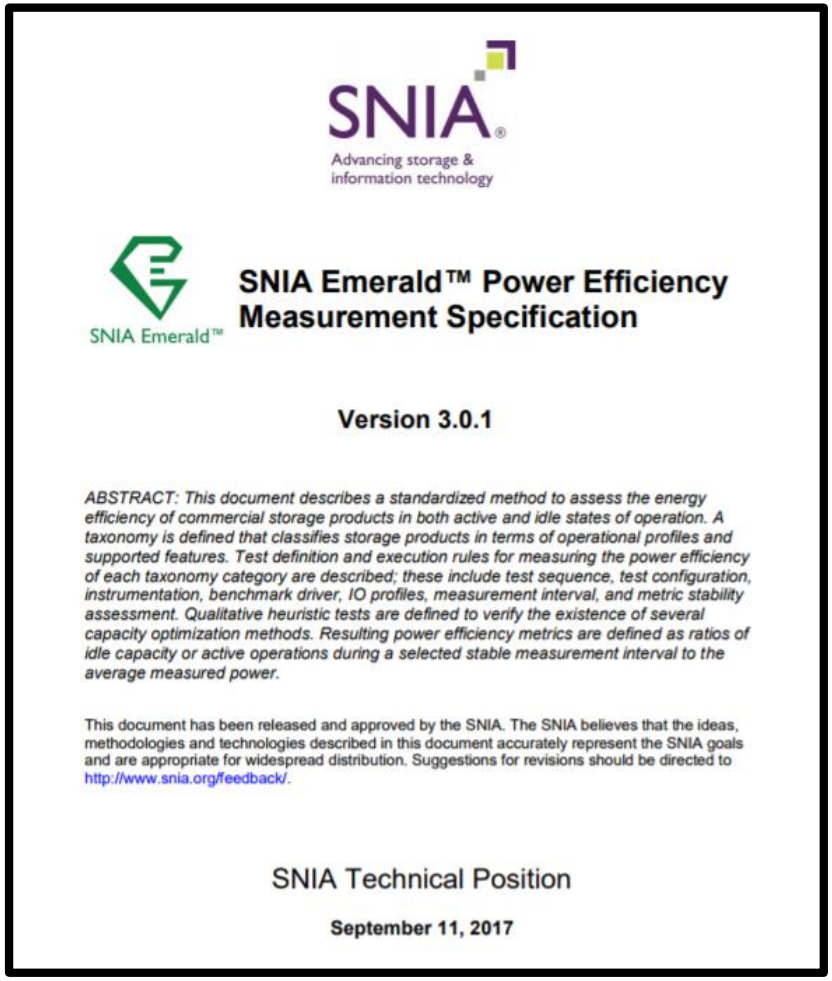
SNIA Emerald™ Specification Building Block for Industry



SNIA Emerald™ Power Efficiency Measurement Specification

SNIA GSI | GREEN STORAGE



SNIA
Advancing storage & information technology

SNIA Emerald™

SNIA Emerald™ Power Efficiency Measurement Specification

Version 3.0.1

ABSTRACT: This document describes a standardized method to assess the energy efficiency of commercial storage products in both active and idle states of operation. A taxonomy is defined that classifies storage products in terms of operational profiles and supported features. Test definition and execution rules for measuring the power efficiency of each taxonomy category are described; these include test sequence, test configuration, instrumentation, benchmark driver, IO profiles, measurement interval, and metric stability assessment. Qualitative heuristic tests are defined to verify the existence of several capacity optimization methods. Resulting power efficiency metrics are defined as ratios of idle capacity or active operations during a selected stable measurement interval to the average measured power.

This document has been released and approved by the SNIA. The SNIA believes that the ideas, methodologies and technologies described in this document accurately represent the SNIA goals and are appropriate for widespread distribution. Suggestions for revisions should be directed to http://www.snia.org/feedback/.

SNIA Technical Position

September 11, 2017

- **Taxonomy**: An industry-wide means of segmenting storage system products that span the range from consumer solutions to enterprise configurations. Used to categorize test results.
- **Test Methodology:** A detailed and consistent means of testing various types of storage systems with load generators and power measurement instruments.
- **Test Metrics - Idle Measurement Test:** **capacity/watt**
  Storage system is configured, powered up, connected to one or more hosts and capable of satisfying externally initiated, application-level initiated IO requests within normal response time constraints, but no such IO requests are being submitted.
- **Test Metrics - Active Measurement Tests:** **performance/watt**
  Storage system is in an "active" state processing externally initiated, application-level requests for data transfer between host(s) and the storage system.
  - 4 corners + hot band - Block IO
  - 4 application workloads – Filer IO
- **Capacity Optimization:** The specification addresses determining whether the storage system supports energy-saving storage capacity optimizations, including features such as deduplication and thin provisioning.

SNIA Emerald™

http://snia.org/tech_activities/standards/curr_standards/emerald

www.sniaemerald.com

SNIA Emerald Taxonomy: Online applies to HDD as well as SSS (hybrid or 100%)

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Table 3 – Common Category Attributes

Attribute	Category			
	Online	Near-Online	Removable Media Library	Virtual Media Library
Access Pattern	Random/ Sequential	Random/ Sequential	Sequential	Sequential
MaxTTFD (t)[a]	t < 80 ms	t > 80 ms	t > 80 ms t < 5 min	t < 80 ms

SNIA Emerald Taxonomy
Size matters….

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5.5 Online Category

This category defines the features and functionalities for an online, random-access storage product. Products in this profile may provide any combination of block, file, or object interfaces. Table 4 defines the requirements for the taxonomy classifications defined in this category.

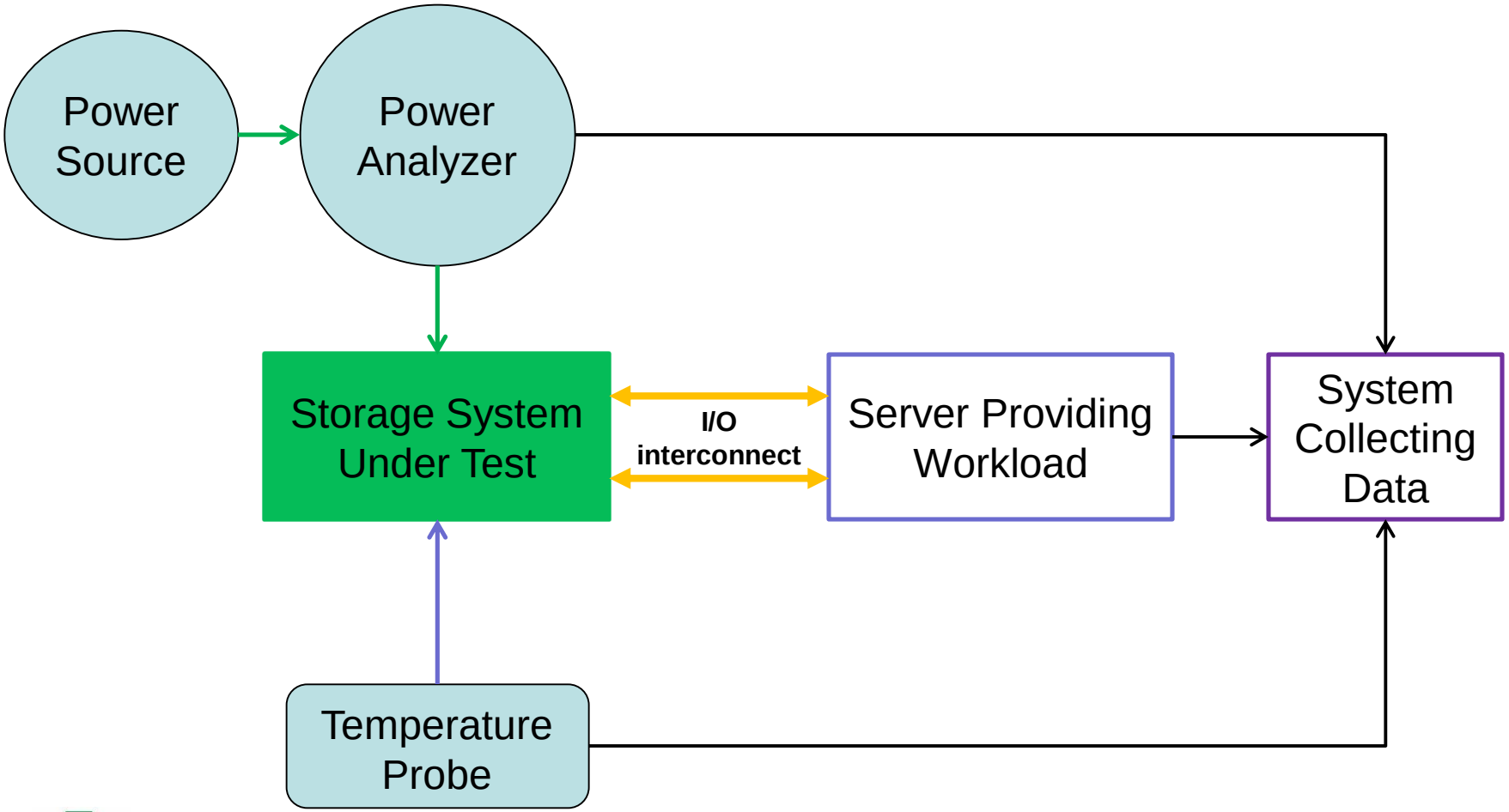
Table 4 – Online Classifications

Attribute	Classification					
	Online 1	Online 2	Online 3	Online 4	Online 5	Online 6
Access Pattern	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential
MaxTTFD (t)	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms
Connectivity	Not Specified	Connected to single or multiple hosts	Network-connected	Network-connected	Network-connected	Network-connected
Consumer/ Component	Yes	No	No	No	No	No
Integrated Storage Controller	Optional	Optional	Required	Required	Required	Required
Storage Protection	Optional	Optional	Required	Required	Required	Required
No SPOF	Optional	Optional	Optional	Required	Required	Required
Stable storage support	Optional, unless Required by protocol	Optional, unless Required by protocol	Required	Required	Required	Required
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Required	Required
FBA/CKD Support	Optional	Optional	Optional	Optional	Optional	Required
Maximum Supported Configuration[1]	≥1	≥ 4	≥ 12	> 100	>400	>400

1. Maximum Supported Configuration does not apply to an all solid-state system that is not based on replaceable storage devices.

SNIA Emerald™

Emerald Test Setup



SNIA Emerald – ENERGY STAR Data Center Storage

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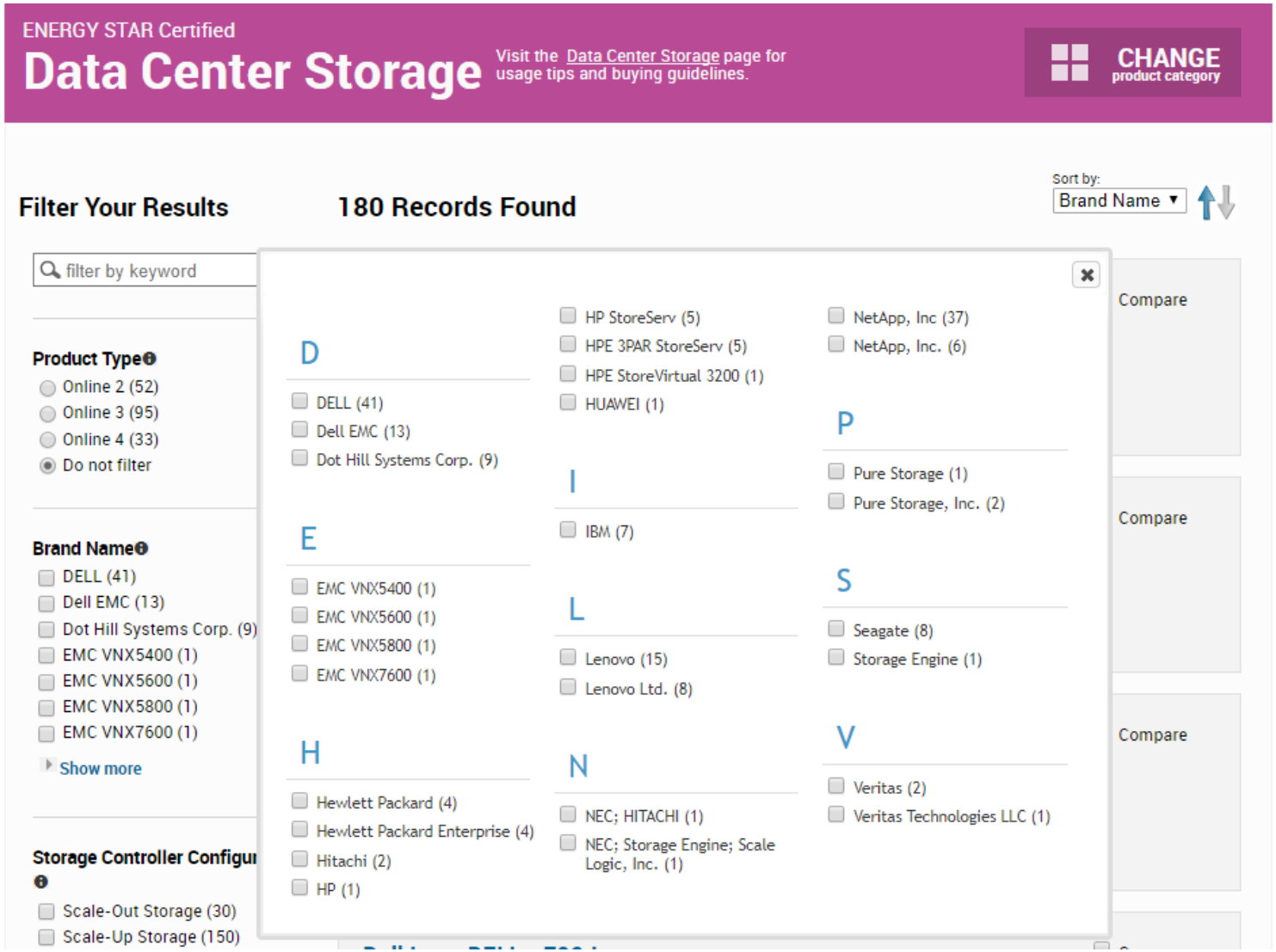
- SNIA collaborated with EPA in defining ENERGY STAR Data Center Storage (DCS) Specification
- EPA adopted the Emerald Specification for test and measurement methodology that must be used for DCS
- DCS measurements
  - Are performed according to the Emerald Specification, *and*
  - Must meet some additional EPA requirements
- SNIA and EPA ongoing collaboration
  - Participates in Emerald Training events
  - Participates in SNIA meetings and industry workshops
  - EPA encouraged SNIA to create Recognized Tester Program
  - Review of industry test data to refine test methods
  - Storage taxonomy classes for future specifications

ENERGY STAR
Data Center Storage Submissions

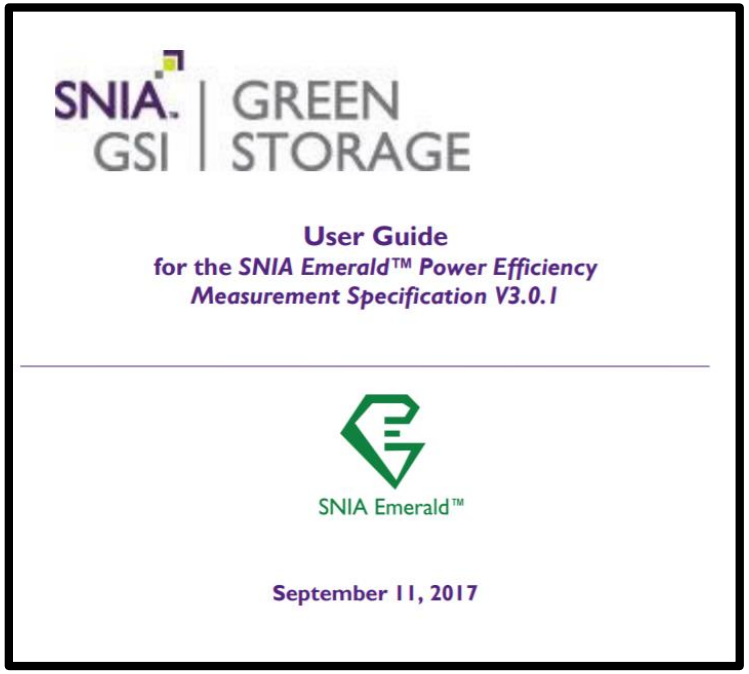
http://www.energystar.gov/productfinder/product/certified-data-center-storage



As of Feb 2018

SNIA Emerald Specification User Guide

- User Guide containing advice on performing measurements according to the Emerald Specification
- Workload generating software tools for driving the storage system under test
- Scripts for operating the software tools
- Test Data Set Generator software for certain tests
- Test Report data, metrics, and SUT configuration for publishing results



SNIA Emerald™

http://sniaemerald.com/download

Training on Emerald Testing

- Slides and videos from past training events available on sniaemerald.com/training web site
  - V2.0.2 4-day training session conducted July 2014
  - V2.1 webinar training session conducted July 2015
- Upcoming Training event
  - **February 2018:** 22 hours of webinar over 2 weeks in 4 hour blocks

SNIA Emerald V3.0 Training Schedule					
			Pacific		
Month	**Date**	**Day**	**Time**	**Format**	**Theme**
February	20th	Tuesday	10am-2pm	webinar	Storage Primer
February	21st	Wednesday	10am-2pm	webinar	SNIA and EPA Program Overview
February	22nd	Thursday	10am-12N	webinar	SNIA Emerald Programs TWG, GSI, RTP
February	27th	Tuesday	10am-2pm	webinar	Emerald 3.0 Specification and Tool Deep Dive
February	28th	Wednesday	10am-2pm	webinar	Generating Emerald Test Data
March	1st	Thursday	10am-2pm	webinar	Analyze and Report Emerald Metrics

Recognized Tester Program (RTP)

- Recognize organizations that have demonstrated proficiency in performing testing in accordance with the Emerald Specification
  - Testing service vendors
  - Independent labs
  - Manufacturers' in-house test teams
- Leverage SNIA Emerald™ training
- Build global ecosystem of quality testers
- Nominal Fee to enroll; awarded Certificate; Emerald Program website listing
- Not required to be a tester for SNIA Emerald or EPA ENERGY STAR
- Validates capabilities to run SNIA Emerald tests, generate/analyze data test results, and complete reports
- No interdependencies with ISO 17025 for test facility
- No interdependencies with EPA registered test labs

Recognized Tester Program

- Available for V2.1 and V3.0 Block IO
- Assessing interest for V3.0 File IO

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SNIA Green TWG and GSI Membership Benefit Matrix

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Activity/Benefit	SNIA GSI Member (Must be SNIA Member)	SNIA Green TWG Member	SNIA Emerald Newsletter (No membership required)
Industry collaboration with national bodies and industry associations for ICT energy efficiency programs, e.g. EPA, EU, APJ, SPEC, TGG, 80Plus	√	√	-
Member/company recognition, industry leadership for energy efficiency, SNIA GSI programs, market development and deliverables	√	-	-
Shape, contribute, and early access to SNIA energy measurement specifications referenced by national bodies, e.g. EPA	-	√	-
Access to technical expertise for energy test and measurement specification methods and development	-	√	-
Discounts on GSI fee-based programs	$$$	$	-
Access approved and published SNIA Emerald documents www.sniaemerald.com	√	√	√
Newsletter and notices for SNIA green storage activities, SNIA Emerald Program	√√	√√	√

GreenTWG planned work activities through 2018

- SNIA Emerald Specification 3.0 (Member approved Sept 2017)
  - File System IO test and measurement methods data analysis
  - Collaboration with EPA Energy Star for EPA V1.1 – cross-referencing SNIA Emerald V3.0 ; Collaboration SNIA-J/METI Japan Top Runner Program
  - Tester training February 2018
  - ISO Submission mid-late year 2018
- Collaboration with Green Grid
  - EU Lot 9 Responses for measurement program, power supply ratings
  - Storage whitepaper w/ block IO analysis; Operational metrics
- SNIA Emerald V4.0 specification development
  - Target completion 2019
  - Address AFA, SDC, Object Storage, adjust taxonomies
- Collaboration with ECOS 80Plus for Power Supplies and Efficiency Ratings

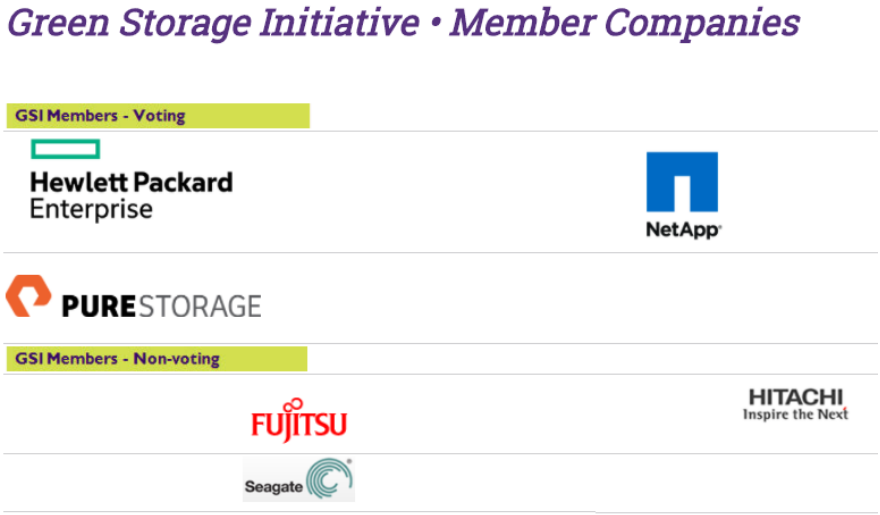
SNIA Green Meetings

- Green Storage Technical Work Group
  - Weekly concalls, 2 hours
  - Face to Face 2-3 day Technical Symposiums held in various locations in USA
    - January, March, May, July, October
  - Coordinated EPA industry stakeholder meetings
    - 2x year
- Green Storage Initiative
  - Weekly concalls, 1 hour
  - 4 hour session during face to face Technical Symposiums

GSI 2018 Members

- GSI Dues Voting - $12000 ; Non-voting $6000

- Fujitsu – Non-Voting
- HDS - Non-voting
- HPE – Voting
- NetApp – Voting
- Pure Storage - Voting
- Seagate –Non-Voting



SNIA and SNIA GSI Membership Fees

- SNIA Base Membership (based on company revenue, small, medium, large; based on vendor)
  - Voting : $8,500 ; $14,500 ; $40,000
  - Non-voting: $3,500 ; $8,500; $15,000
  - Non-vendor categories are less per tier for voting/non-voting
- SNIA Green Storage Initiative (no tiers for revenue); requires SNIA Base membership
  - Voting : $12,000
  - Non-voting : $6,000
- Special one-time discounts may be available, speak with membership services director Erin Weiner, erin.weiner@snia.org
- Other GSI program fees
  - Recognized Tester Program ; $12,000 for assessment, *discounted 25% GSI; 10% SNIA

SNIA GSI Allocation of GSI Membership Fees

- TWG supported services (35%)
  - Technical writer
  - Special testing projects
  - Subject matter experts
  - Face to face meeting costs
- GSI Programs (40%)
  - SNIA Emerald Program Manager
  - SNIA Recognized Tester Program (additional applicant fees)
  - SNIA Emerald Training
  - Program adoption and market development
- Core SNIA infrastructure and services (25%)
  - Web presence, collaboration tools, SNIA staff, legal and accounting services, etc.

Advancing SNIA Green without being a paid-member of SNIA

- Individual membership fee waived in exchange for active participation and contributions to GreenTWG and GSI deliverables.
  - Email emerald@snia.org
- Technical contribution to SNIA Specification via Contributors License Agreement (CLA)
  - https://www.snia.org/opensource

Resources

- SNIA Green Storage Initiative
  - http://www.snia.org/forums/green
  - Green storage tutorials, white papers, and alliances
- SNIA Emerald™ Program
  - http://sniaemerald.com
  - SNIA Emerald Test Specification
  - Comprehensive online technical training
  - Storage vendor product listing with measured energy usage metrics
  - SNIA Emerald Recognized Tester Program
- USA EPA ENERGYSTAR Data Center Storage
  - Specification:
    https://www.energystar.gov/products/spec/data_center_storage_specification_version_1_0_pd
  - Storage vendor product listing with measured metrics
    - http://www.energystar.gov/productfinder/product/certified-data-center-storage

Questions ?

Contact us at:
emerald@SNIA.org